Implementing Book-end Division Approach using ClassPoint to Energize Electrical and Electronics Engineering Student Engagement

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Abstract
This study investigates the efficacy of using ClassPoint in improving student engagement during class and its impact on academic performance among electrical and electronics engineering students by using student engagement framework that established by technology-enhanced learning (TEL) environment microsystem. To achieve this objective, five instructors teaching various courses incorporated ClassPoint into their classes. Then, quantitative data on student engagement and academic performance were collected via surveys. The student's comments are extracted from university teaching evaluation survey (EPAT) for thematic analysis. The descriptive analysis revealed a significant increase in student engagement after ClassPoint was implemented. Furthermore, students appreciated the use of ClassPoint features such as slide-drawing, multiple choice questions, and word clouds during classes. Survey results also show students have greater attentiveness, active participation, and improved interactions with their peers and instructors. Likert scale responses indicate positive correlation between the use of ClassPoint and students' enhanced performance in class discussions, idea integration, increased interest in learning, and improved classroom dynamics. Moreover, thematic analysis shows the empowering of five element in TEL microsystem with ClassPoint increase the student engagement. This study highlights ClassPoint's effectiveness in creating an inclusive and interactive learning environment, thus, transforming teaching methods for electrical and electronics engineering students.

Keywords: ClassPoint, student engagement, classroom dynamics, learning environment, e-learning.

Introduction

Student engagement in class is very important in ensuring that the delivery of lectures is well distributed. Some students may find it challenging to understand electrical and electronics engineering courses at times because, for example, they are unable to see how electricity flows with the naked eye. Hence, the motivation of this study is to enhance the learning experience of Electrical and Electronics Engineering in the classroom.

The student engagement framework by (Bond & Bedenlier, 2019) as shown in Figure 1, represents the relationship between student engagement and outcomes within a Technology-enhanced Learning (TEL) microsystem. Student engagement is influenced by a range of factors. Within TEL microsystem, the integration of technology empowers teachers, activities, the environment, and peers. Proficient utilization of technology in the learning environment and community fosters active student engagement, consequently yielding a spectrum of short- and long-term academic and social outcomes. The short-term outcome elevated higher-order thinking skills, heightened motivation, and improved interpersonal connections facilitated by peer-to-peer learning and collaboration. In the long term, these outcomes contribute to lifelong learning, enhanced personal development, and heightened participation in the broader educational community. Importantly, the commitment and energy invested by students circulate back into the TEL activities and learning environment, establishing a reciprocal dynamic.

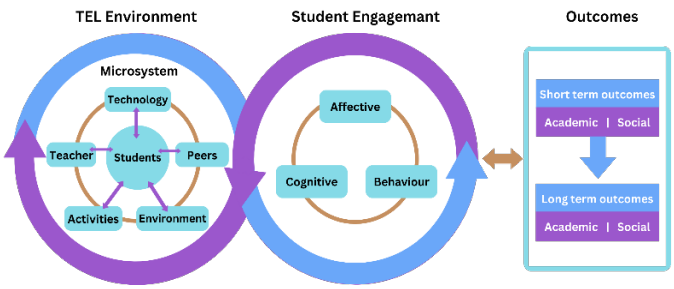

Figure 1. Student engagement framework (Bond & Bedenlier, 2019)

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Traditional teaching methods often struggle to engage students in technical fields. Thus, the TEL environment in student engagement framework was used, and this study aims to address this challenge by making learning more interactive and participatory, especially in online teaching and learning setup. A study published in Ref. (Libre, 2021) found that there was a dearth of interaction during online learning between students and instructors or between students themselves. By creating interactive and engaging classrooms, students can actively participate, think critically, collaborate, and navigate digital platforms effectively. This approach ensures that students not only excel academically but also acquire the 21st-century skills as shown in Table 1, making their learning experiences more comprehensive and applicable. We employed the book-end approach as active learning approach in our class to increase the student engagement. Active learning involves students in the learning process through activities that encourage critical thinking, problem-solving, and engagement. Within the TEL microsystem, technology acts as a catalyst for active learning.

Table 1. 21st century skills (Helmi et al., 2019)

Foundational Literacy	Competencies	Character Qualities
· Literacy · Numeracy · Scientific literacy · ICT literacy · Financial literacy · Cultural and civic literacy	· Critical thinking /Problem solving · Creativity · Communication · Collaboration	· Curiosity · Initiative · Persistence / grit · Adaptability · Leadership · Social and cultural awareness
Lifelong learning		

Moreover, traditional lectures often struggle to captivate the attention of students, especially in engineering disciplines. The motivation arises from the aspiration to make learning an engaging and interactive experience, ensuring that students are not just passive recipients of information but active participants in their learning process. Student engagement, according to (Villiers & Amanda Werner, 2018) is the act of participating in activities and circumstances that are associated with high-quality learning. In student engagement framework; behaviour, emotion, and cognitive components all play a part in the meta-construct of student engagement during learning process (Hassona, 2020). Keeping students connected with the course and, their learning is a key element in successful student engagement (Dixson, 2015). Therefore, the ability of the instructor to design and create a welcoming class for student engagement is extremely important.

Moreover, integrating teaching with educational tools is crucial for enhancing student engagement in the classroom. Sometimes educators feel alone when giving lectures (N.E. Ghazali, 2021). In today's digital age, students are accustomed to interactive and dynamic learning environments. Utilizing educational tools not only captures their attention but also provides a more immersive and participative learning experience. These tools can transform abstract concepts into visual and interactive lessons, making the learning process more engaging and memorable. Concurrently, several studies have demonstrated that the use of instructional tools increases student engagement for the instructor (Nadeem, 2019)(Gon & Rawekar, 2017)(Alim et al., 2019). However, if you are teaching using Microsoft PowerPoint, all the educational tools must be used across multiple platforms.

In this study, we are using ClassPoint as an educational tool to support the book-end approach in our teaching and learning. ClassPoint is the all-in-one plug-in application in PowerPoint that allow multiple interactive activities for online and face-to-face class. Previously used multiple platforms for the interactive activities, it was so tedious to change from one platform to another platform during the lecture. Table 2 shows the comparison of engagement tools without ClassPoint versus those with ClassPoint. The ClassPoint eliminates the need to use multiple platforms for class engagement.

Table 2. The comparison of engagement tools.

Activity	Engagement tools before using ClassPoint	Engagement tools after using ClassPoint
Opening	Mentimeter, Kahoot!, Quizizz, socrative	All-in-one teaching tool in PowerPoint Multiple Choice, Word Cloud, Short Answer, Slide Drawing, Image Upload, Fill in the Blanks, Audio Record, Video Upload
Intermittent discussion	padlet, Jamboard	
Closure	Mentimeter, Kahoot!, Quizizz, Kahoot!	

The features inside the ClassPoint already cover other engagement tools such as multiple choice, word cloud, short answer, slide drawing, image upload, fill-in-the-blanks, audio recording, and video upload. This choice is enough for the lecturer to handle the activities in their classes without use another platform.

Procedure of Proposed Approach using Class Point

Class Design using Book-end Approach

The book-end approach is the easiest instructional design of the active learning method that divides the classroom session into three parts; advanced organizing, intermittent discussion, and closure (Helmi et al., 2019). Advanced organizing is an introduction session to activate prior knowledge of the students. Intermittent discussion helps student to engage with the topic's learned, active learning activities where student can discuss among themselves is happened here. While the closure session used to summarize the class session and obtain students' understanding. Figure 2 shows the instructional design for a 50-minute class session based on the book-end division approach. In traditional teaching, most of the time is one-way communication happened, where only the lecturer giving lecture. By using this approach, the class session is divided into several session to allow student participation in class activities. The lecture session is chunk into several session to giving students time to digest all the new knowledge.

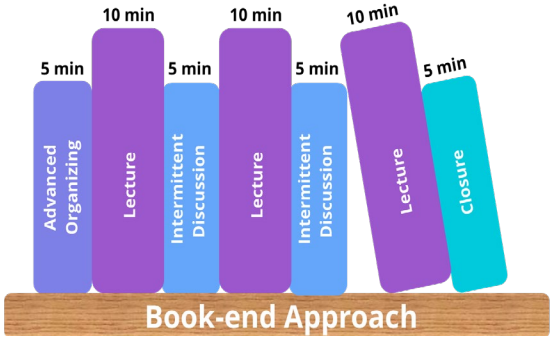

Figure 2. Book-end division approach (Smith et al., 2009)

The TEL microsystem is established by incorporating the book-end approach with ClassPoint as shown in Table 3. There are multiple active learning activities offered in ClassPoint, such as multiple-choice question, word cloud, short answer, slide drawing and image upload. Each class is unique. At the beginning of each class session, class code is given to the students. After joining the class, student can participate in all activities by using their handphone, computer or tablet. All the students' responses for each activity is received in real-time and lecturer can give immediate feedback that helps student boost their understanding during class session. This will reinforce student's engagement in the learning process and promoting continuous improvement.

Student Engagement Survey Design

To implement ClassPoint among electrical and electronics engineering students, we have identified several factors, which are: survey on the current method for student engagement and identify the courses that are possible to be used as the test data for our approach.

Table 3. Active learning activities using ClassPoint.

Book-end Division session	ClassPoint Activity
Advanced Organizing	Word cloud, multiple-choice question, short answer
Intermittent discussion	Slide drawing, image upload, multiple-choice question
Closure	Word cloud, multiple-choice question, short answer

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A survey was designed to measure the student engagement based on cognitive engagement, behaviour engagement and affective engagement. Cognitive engagement is defined as how much students are willing to work hard and understand difficult concepts and skills. On the other hand, affective engagement is about how students feel about their teachers, classmates, school, and if they feel like they belong there. Behavioral engagement refers to how students participate in class, behave, and take part (Maroco et al., 2016). In this study, we are focusing on cognitive engagement of the students during class session, outside classroom and the impact on assessment preparation.

We are studying how students engage in electrical and electronics engineering classes, by referring to established methodologies and question structures from the survey Utrecht Work Engagement Scale (UWES) design by (Schaufeli & Bakker, 2010). The UWES is develop to measure the work engagement for workers. This survey was adapted to measure student engagement in university settings (Bresó et al., 2011).

The survey instrument was designed to collect data on demographic characteristics, student engagement, perceptions of technology use in the classroom, and student impression of the class atmosphere. The demographic information collected included gender, race, and learning mode. It consisted of 39 questions, including multiple-choice and 5-point Likert scale.

There are two phases to verify the quality assurance of the question survey. The first phase is a pilot test. A pilot test was conducted with a small group of 5 participants to assess the clarity, relevance, and effectiveness of the survey questions. The pilot sample's results were not included in the analysis. After the correction of the pilot test, it went through the second phase of verification, which is a review from an expert in education field. An expert from UTM has

been appointed, Dr. Mohd Fadzil Daud from Center for Engineering Education (CEE) to review the question survey. After that, the survey was administered online over a period of one week after end of the semester for two consecutive semesters. The data collected were organised, categorised, and tabulated by using excel file. Finally, the data were presented using descriptive analysis in the form of frequency, and percentage.

University Teaching Evaluation System

Moreover, for every semester, student will evaluate the lecturer twice by using teaching evaluation survey (EPAT) establish by the Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA). After each semester, all the feedbacks and comments from students is available for each lecturer. The feedbacks were used by the lecturer and faculty for continuous quality improvement. The related comments with class data were thematically analyze to complement the quantitative findings and provide a more holistic view of student engagement in the used framework.

Results and Discussion

The study involved a sample size of 130 participants from Electrical and Electronics Engineering students. Participants in the survey were undergraduate degree and diploma students enrolled in courses stated in Table 4 at Faculty of Electrical and Electronics Engineering Technology (FTKEE), UMPSA. A majority of the sample belonged to degree students (74%) and 36% is from diploma level as tabulated in Table 4.

Table 4. Electrical and electronics engineering courses participate in this study.

Course Code	Course Name	Level
BHE1213	Digital Electronics	Degree Number: 96 Percentage: 74%
BTE3222	Digital Logic Design Laboratory	
BTE3243	Electronics 2	
BTE3223	Digital Logic Design	
BTE4743	Power Electronics	
BTS3133	Signals and Networks	
BTS4253	Computer Vision System	
BVE1124	Technical Reporting	
DRE1213	Computer Programming	Diploma Number: 34 Percentage: 26%
DRE1223	Digital Electronics	
DRE2213	Programming and Data Structure	

Table 5 shows there are 70% male and 30% female students' participant in this study. The demographic data reveals a diverse composition of the participants, with 75% identifying as Malay, 10% as Chinese, 10% as Indian, and 5% falling under the "Other" category. In terms of learning mode preferences, 62% participants are from face-to-face class, 31% attending a hybrid learning, combining in-person and online components, and 7% attending fully online learning mode.

Table 5. Demographic characteristics of the students.

Profile		Number	Percentage
Gender	Male	91	70%
	Female	39	30%
Race	Malay	97	75%
	Chinese	13	10%
	India	13	10%
	Other	7	5%
Learning mode	Face-to-face	81	62%
	Hybrid	40	31%
	Online	9	7%

The findings for this research will only concentrate on a few tools that the instructors actively utilized in the ClassPoint courses that were selected in the above section. Figure 3 shows the frequency distribution of tools in ClassPoint that have been actively applied during class session. The multiple-choice question type contributed the most to student involvement (35%), followed by the short answer (24%), and other categories (18% - image upload, 15% - word cloud, and 8% - slide drawing). It is very useful when a lecturer spontaneously wants to ask simple questions to the students regarding their lectures. Multiple choice is a simple tool that can be used by the lecturer and all the students can see the result in real time.

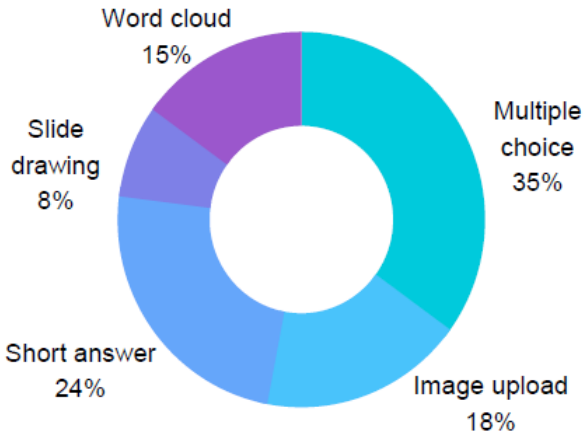

Figure 3. Tools in ClassPoint that had been actively applied

The Likert scale responses reveal enhanced performance in class discussions and idea integration as shown in Figure 4. ClassPoint positively contributes to student's participation in group discussions and asking questions. More than 100 students are clearly in

agreement that they are actively participating in discussions in small groups and raising questions when they do not understand the instructor. The findings indicate that ClassPoint not only enhances individual engagement but also contributes to a vibrant and interactive classroom ecosystem, essential for holistic learning experiences.

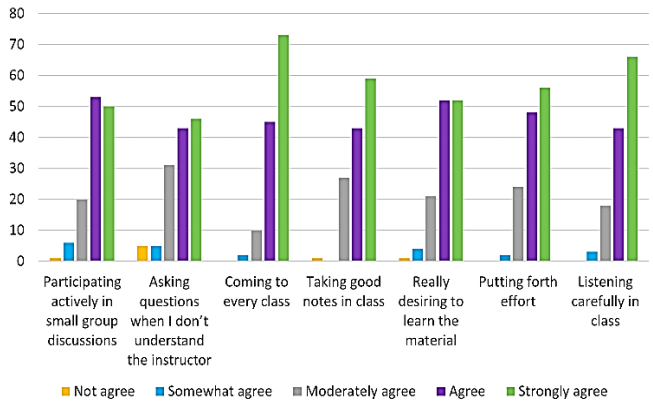

Figure 4. Student engagement during class session

In addition, the observed data shows that more than 102 students agree and strongly agree they are actively participating in cognitive engagement. Also, more than 78% of the students consistently attend, take good notes, desire to learn, exert effort, and listen actively to achieve higher academic performance, deeper comprehension, and a more enriching educational experience. These indicators collectively signify a high level of cognitive engagement, suggesting that students are not only physically present in class but actively participating, processing information, and demonstrating a genuine interest in learning.

Moreover, the results illustrated in Figure 5 indicate that cognitive engagement echoes students' independent learning outside the classroom. By using this approach, students not only actively participate during class but also demonstrate a commitment to ongoing learning, such as doing all homework and regularly thinking about the course. This extended engagement, beyond the confines of class meetings, reflects a proactive and self-directed approach to understanding the course material. From Figure 5, it can be observed that less than 10% of the students do not agree with the approach that helps them to engage with the course outside the classroom.

On the other hand, more than 68% of the students agree and strongly agree that they are engaged with the course outside of classroom sessions. Such students are likely to have a deeper appreciation for the course content.

The correlation between classroom engagement and outside-class activities further influences students' efforts and preparation in completing assessments for successful learning outcomes as shown in Figure 6. About 103 students are agree and strongly agree that they will seeking clarification through questions when faced with uncertainty about assessments, such as quizzes, tests, exams, projects, or assignments. A significant majority, more than 72% of the students recognize the correlation between actively participating in class and achieving good grades.

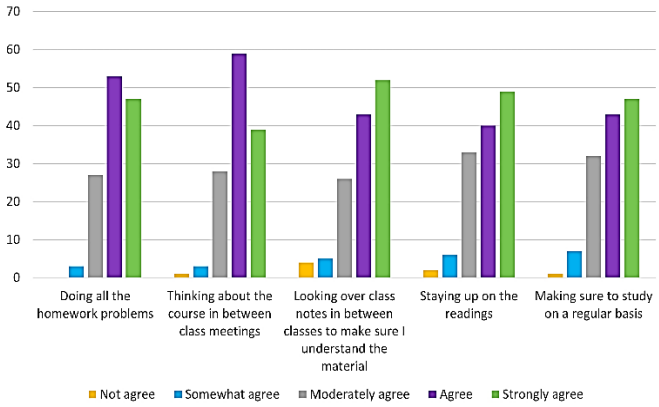

Figure 5. Student effort to engage with the knowledge outside classroom session

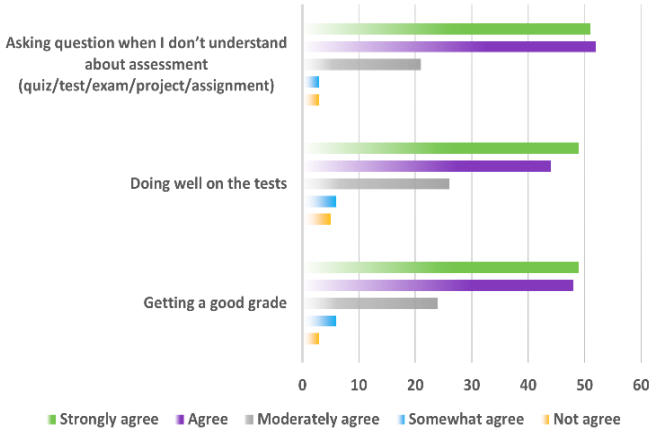

Figure 6. Student effort to engage with the knowledge in getting good grade

These actions underscore a proactive approach to learning, emphasizing both academic excellence and a commitment to understanding the material thoroughly. By prioritizing comprehension, diligent preparation, and seeking clarity, students lay the foundation for not only academic success but also for a deeper and more meaningful engagement with their educational journey.

Furthermore, the thematic analysis has been done by using related comments extracted from the UMPSA teaching evaluation survey (EPAT). The provided feedback from the EPAT reflects a positive engagement within the TEL environment, aligning with the Student Engagement Framework. The microsystem, enriched by the integration of technology using ClassPoint, plays a pivotal role in fostering an interactive and enjoyable learning experience. The data were thematically analyzed and the findings shows high correlation with the student engagement framework.

1. *Effective technology integration.*

   Feedback 1: "Interesting use of technology and very clear presentation."
   Feedback 2: "She knows how to use technology to make students understand each subject and very interesting lecturer."

The feedback emphasizes the lecturer's adept use of technology, indicating that the microsystem effectively integrates technology to capture student interest and enhance clarity in content delivery.

2. *Peer interaction and enjoyable environment.*

   Feedback 3: "I like the way the lecturer let the students approach each other using the class point because it's fun."
   Feedback 4: "Fun approach to learning. Explained everything in detail and made it easier for me to understand."
   Feedback 6: "Learning using ClassPoints is fun. Madam is an understanding person."

The use of ClassPoint is noted for facilitating peer interaction, injecting an element of fun into the learning process. This aligns with the framework's emphasis on environment and enjoyable learning experiences as one of the elements for increasing student engagement.

3. *Formative assessment as learning activities.*

   Feedback 5: "She always explains every problem we ask in more detail, and also madam conducts some pop quizzes during class which are really fun."

The incorporation of detailed explanations during lecture and formative assessments as intermittent discussion, such as pop quizzes, aligns with the framework's focus on academic challenge and supportive feedback, contributing to cognitive engaging and dynamic learning activities.

Conclusion

Based on the use of ClassPoint to implement the book-end division approach in student engagement framework, the results of the study indicate a very positive response among students in the electrical and electronics engineering field. The use of ClassPoint in TEL microsystem has been shown to increase student cognitive engagement, which is a critical factor in student success. The book-end division approach, which involves providing students with a clear understanding of the learning objectives at the beginning of a lesson and then revisiting those objectives at the end of the lesson, has been shown to be an effective way to increase student engagement.

Overall, the findings of this study suggest that the use of ClassPoint and the book-end division approach in TEL microsystem can be an effective way to improve student engagement in the electrical and electronics engineering field. Future work research is needed to explore the potential benefits of this approach in other fields and to identify best practices for implementation.

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